PATENT SPECIFICATION 829,286

NO DRAWINGS.

Inventors:—
EVAN HERBERT NELSON and SYDNEY ALFRED RICHARD RIGDEN.

Date of filing Complete Specification: May 17, 1956.

Application Date: May 3, 1955. No. 15604/55.
(Patent of Addition to No. 801,482, dated Jan. 27, 1955).

Complete Specification Published: March 2, 1960.

Index at Acceptance:—Classes 39(1), D5A, D9(A:B:C:D), D11, D12(A:B2:B4:C:D:E), D35; and 56, M11B1, MS5.

ERRATUM

SPECIFICATION NO. 829,286

Page 1 in the heading *for* "Application Date: May 3, 1955" *read* "Application Date: May 31, 1955".

THE PATENT OFFICE,
30th May, 1960

and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sodium vapour electric discharge lamps of the positive column type and is a modification of the invention which forms the subject matter of the Complete Specification filed in respect of cognate Patent Applications Nos. 2517/54 and 20306/54 (Patent Specification No. 801,482).

According to the invention described and claimed in said Complete Specification in a sodium vapour electric discharge lamp of the positive column type having an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely round the limb along the whole or the greater part of the length of the limb.

The term "fits closely" implies that the

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along the whole or the greater part of the length of the sleeve, the sleeve is not in such intimate contact with the wall of the limb around its whole periphery as in effect, as regards loss of heat, merely to constitute a thickening of the wall of the limb, and does not include sleeves which consist merely of coatings on the walls of the limbs.

When the sleeves and limbs are not of circular cross-section, the term "diameter" means the maximum diameter in the corresponding cross-section, that is to say, the longest straight line which can be drawn joining two points on the inner or outer periphery, as the case may be, of the cross-section. Preferably the internal diameter of each sleeve is only slightly greater, for example not more than two millimetres greater, than the external diameter of the limb on which it is fitted.

The close fitting sleeves in accordance with said invention serve to reduce the rate of loss of heat from the discharge envelope by the absorption and/or reflection of radiation emanating from the envelope, particularly the infra-red radiation, and thereby enable the lamp to operate at a higher luminous efficiency; for example the lamp may be arranged to operate at a higher sodium vapour pressure than possible for the same current density with a lamp of similar construction not provided with such sleeves, or

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International Classification :—C03b, c. H01j.

COMPLETE SPECIFICATION.

Improvements in or relating to Sodium Vapour Electric Discharge Lamps.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sodium vapour electric discharge lamps of the positive column type and is a modification of the invention which forms the subject matter of the Complete Specification filed in respect of cognate Patent Applications Nos. 2517/54 and 20306/54 (Patent Specification No. 801,482).

According to the invention described and claimed in said Complete Specification in a sodium vapour electric discharge lamp of the positive column type having an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely round the limb along the whole or the greater part of the length of the limb.

The term "fits closely" implies that the internal diameter of the sleeve is not more than 50% greater than the external diameter of the limb of the discharge envelope on which it is fitted, the diameters being taken in a cross-section at right angles to the axis of the sleeve or limb, and also implies that along the whole or the greater part of the length of the sleeve, the sleeve is not in such intimate contact with the wall of the limb around its whole periphery as in effect, as regards loss of heat, merely to constitute a thickening of the wall of the limb, and does not include sleeves which consist merely of coatings on the walls of the limbs.

When the sleeves and limbs are not of circular cross-section, the term "diameter" means the maximum diameter in the corresponding cross-section, that is to say, the longest straight line which can be drawn joining two points on the inner or outer periphery, as the case may be, of the cross-section. Preferably the internal diameter of each sleeve is only slightly greater, for example not more than two millimetres greater, than the external diameter of the limb on which it is fitted.

The close fitting sleeves in accordance with said invention serve to reduce the rate of loss of heat from the discharge envelope by the absorption and/or reflection of radiation emanating from the envelope, particularly the infra-red radiation, and thereby enable the lamp to operate at a higher luminous efficiency; for example the lamp may be arranged to operate at a higher sodium vapour pressure than possible for the same current density with a lamp of similar construction not provided with such sleeves, or

the diameter of the discharge envelope in a lamp in accordance with said invention may be increased over that used in an unsleeved lamp to enable the former to attain the same vapour pressure at a lower current density than is possible with the latter.

In general it is preferable to utilise the effect in the second of the two ways, since in most cases an increase in the sodium vapour pressure is liable to shorten the useful life of the lamp by increasing the rate of attack of the sodium vapour on the inner surface of the discharge envelope and/or by accelerating the rate of sodium migration within the discharge envelope; in some cases a combination of the two ways may be used.

One known form of glass commonly employed in the manufacture of discharge lamp envelopes is soda glass having an approximate composition as follows:—

		Parts by weight
SiO_2	...	70.0
Al_2O_3	...	2.5
CaO	...	5.5
MgO	...	3.5
Na_2O	...	17.0
K_2O	...	0.4
B_2O_3	...	0.8
SO_3	...	0.2

This glass, which is hereinafter and in the appended claims referred to simply as said soda-glass, is suitable for forming the sleeves of a lamp in accordance with said invention, giving good heat conservation and enabling high luminous efficiencies to be obtained.

The object of the present invention is to provide, in a lamp provided with close fitting heat insulating sleeves in accordance with the invention claimed in Patent Specification No. 801,482, means whereby still further increases in the luminous efficiency may be obtained.

According to the present invention at least one, and preferably each, said sleeve wholly or partly consists of a material which is highly transparent to the visible radiations of 5890Å and 5896Å wavelength emitted by the sodium vapour discharge, but which is such that the proportion of the incident infra-red radiations from the discharge which is directly transmitted through the sleeve (that is to say, which is not reflected or absorbed) is appreciably less than the proportion of the said infra-red radiations which would be directly transmitted through a sleeve of the same dimensions formed wholly of said soda glass.

Thus in one form of lamp in accordance with the invention at least one of the sleeves may be wholly or partly formed of a phosphate glass which has an appreciably higher absorption factor, and not significantly less reflection factor, for infra-red radiations than has said soda glass, but which at the same time is transparent to the yellow sodium light.

For example one particular glass which possesses the above properties is the phosphate heat absorbing glass manufactured by Chance Brothers Limited and known as ON20.

Another suitable phosphate glass possessing these properties has substantially the following composition by weight:—

P_2O_5	...	67.44%
Al_2O_3	...	13.44%
CaO	...	7.12%
B_2O_3	...	5.00%
SiO_2	...	5.00%
Fe_2O_3	...	2.00%

Other suitable glasses will be apparent to those skilled in the art of glass technology.

In an alternative form of lamp in accordance with the invention at least one of the sleeves may consist of a glass cylinder coated on one surface or on each of its surfaces with a thin film which is highly transparent to the yellow sodium light, but which has a high absorption and/or reflection factor for infra-red radiations so that the proportion of the incident infra-red radiations from the discharge which is directly transmitted through the sleeve (that is to say, which is not reflected or absorbed) is appreciably less than the proportion of the said infra-red radiations which would be directly transmitted through a sleeve of the same dimensions formed wholly of said soda glass.

The glass cylinder should, of course, also be highly transparent to the yellow sodium light.

Such a film may consist, for example, of a thin coating of a metal such as copper or gold, or alternatively of titanium dioxide or stannic chloride, the thickness of the film being of such a small value that very little absorption of the visible light from the sodium vapour discharge takes place. The use of such films for preventing heat-losses by radiation is well known.

The formation of the film on the glass cylinder in such an arrangement may be effected in any convenient manner, depending on the nature of the material from which the film is formed, for example by thermal evaporation, sputtering, or chemical decomposition.

The glass cylinder itself may be formed of a suitable phosphate infra-red absorbing glass as aforesaid although in some cases it may be formed of a common soda glass, the low infra-red transmitting properties of the sleeve being provided by the said film

or films on one or both surfaces of the sleeve.

The sleeves in a lamp in accordance with the invention may merely be slid on to the limbs and held in position by means which restrain the sleeves against relative longitudinal displacement but without the sleeves being attached to the limbs and without the intervention of spacing means between the sleeves and the limbs; alternatively the sleeves may be attached to the limbs on which they are fitted at one or more regions whose total axial length is small compared with the axial length of the limbs.

For example a lamp in accordance with the present invention may be constructed substantially as shown in and described with reference to the drawings accompanying Provisional Specification No. 2517/54 or No. 20306/54 (Patent Specification No. 801,482), with one or both of the sleeves wholly or partly formed of a glass which has a high absorption factor for infra-red radiations and a reflection factor which is not significantly less than that of said soda glass so that the transmission by the sleeve or sleeves of the infra-red radiations emanating from the discharge envelope in use of the lamp is appreciably less than the transmission of said radiations by a sleeve of similar dimensions formed wholly of said soda glass, but which is also highly transparent to yellow sodium light, such as one of the glasses hereinbefore specifically referred to.

Alternatively in either of the lamps illustrated in Patent Specification No. 801,482 each sleeve may be formed of a common soda-glass coated on one or both surfaces with a thin film which is highly transparent to the yellow sodium light, but which has a high absorption and/or reflection factor for infra-red radiations, such as copper, gold, titanium dioxide or stannic chloride, such that the proportion of infra-red radiations which is transmitted directly through the sleeve is appreciably less than the proportion which would be transmitted directly through the sleeve in the absence of the coating or coatings.

WHAT WE CLAIM IS:—

1. A sodium vapour electric discharge lamp of the positive column type having an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, in which the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and in which each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely (as hereinbefore defined) round the limb along the whole or the greater part of the length of the limb, wherein at least one, and preferably each, said sleeve wholly or partly consists of a material which is highly transparent to the visible radiations of 5890Å and 5896Å wavelength emitted by the sodium vapour discharge, but which is such that the proportion of the incident infra-red radiations from the discharge which is directly transmitted through the sleeve is appreciably less than the proportion of the said infra-red radiations which would be directly transmitted through a sleeve of the same dimensions formed wholly of said soda glass (as hereinbefore defined).

2. A sodium vapour electric discharge lamp according to Claim 1, wherein at least one, and preferably each, said sleeve is wholly or partly formed of a phosphate glass which is highly transparent to the visible radiations of 5890Å and 5896Å wavelength emitted by the sodium vapour discharge but which has an appreciably higher absorption factor, and not significantly less reflection factor, for infra-red radiations than has said soda glass.

3. A sodium vapour electric discharge lamp according to Claim 2 wherein the phosphate glass has substantially the following composition by weight:—

P_2O_5	...	67.44%
Al_2O_3	...	13.44%
CaO	...	7.12%
B_2O_3	...	5.00%
SiO_2	...	5.00%
Fe_2O_3	...	2.00%

4. A sodium vapour electric discharge lamp according to any preceding claim wherein at least one of said sleeves consists of a glass cylinder which is highly transparent to the visible radiations of 5890Å and 5896Å wavelength emitted by the sodium vapour discharge and which is coated on one surface or on each of its surfaces with a thin film which is also highly transparent to said radiations, and which has a high absorption and/or reflection factor for infra-red radiations so that the proportion of the incident infra-red radiations from the discharge which is directly transmitted through the sleeve is appreciably less than the proportion of the said infra-red radiations which would be directly transmitted through a sleeve of the same dimensions formed wholly of said soda glass (as hereinbefore defined).

5. A sodium vapour electric discharge lamp according to Claim 4 in which the said film consists of copper or gold.

6. A sodium vapour electric discharge lamp according to Claim 4 wherein the said film consists of titanium dioxide or stannic chloride.

For the Applicants,
J. E. M. HOLLAND,
Chartered Patent Agent.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Sodium Vapour Electric Discharge Lamps.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British Company, do hereby declare this invention to be described in the following statement:—

This invention relates to sodium vapour electric discharge lamps of the positive column type and is a modification of the invention which forms the subject matter of the Complete Specification filed in respect of cognate Patent Applications Nos. 2517/54 and 20306/54.

According to the invention described and claimed in said Complete Specification a sodium vapour electric discharge lamp of the positive column type has an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely round the limb along the whole or the greater part of the length of the limb.

The term "fits closely" implies that the internal diameter of the sleeve is not more than 50% greater than the external diameter of the limb of the discharge envelope on which it is fitted, the diameter being taken in a cross-section at right angles to the axis of the sleeve or limb, and preferably the internal diameter of each sleeve is only slightly greater, for example not more than two millimetres greater, than the external diameter of the limb on which it is fitted.

When the sleeves and limbs are not of circular cross-section, the term "diameter" means the maximum diameter in the corresponding cross-section, that is to say, the longest straight line which can be drawn joining two points on the inner or outer periphery, as the case may be of the cross-section.

The close fitting sleeves in accordance with said invention serve to reduce the rate of loss of heat from the discharge envelope by the absorption and/or reflection of radiation emanating from the envelope, particularly the infra-red radiation, and thereby enable the lamp to operate at a higher luminous efficiency; for example the lamp may be arranged to operate at a higher sodium vapour pressure than possible for the same current density with a lamp of similar construction not provided with such sleeves, or the diameter of the discharge envelope in a lamp in accordance with said invention may be increased over that used in an unsleeved lamp to enable the former to attain the same vapour pressure at a lower current density than is possible with the latter.

In general it is preferable to utilise the effect in the second of the two ways, since in most cases an increase in the sodium vapour pressure is liable to shorten the useful life of the lamp by increasing the rate of attack of the sodium vapour on the inner surface of the discharge envelope and/or by accelerating the rate of sodium migration within the discharge envelope; in some cases a combination of the two ways may be used.

The object of the present invention is to provide, in a lamp provided with close fitting heat insulating sleeves as aforesaid, means whereby still further increases in the luminous efficiency may be obtained.

According to the present invention at least one, and preferably each, said sleeve wholly or partly consists of a material which is highly transparent to the visible radiations of 5890Å and 5896Å emitted by the sodium vapour discharge but which renders the sleeve highly absorbent and/or reflecting to the infra-red radiations emanating from the discharge envelope.

The statement that a sleeve is highly absorbent and/or reflecting to the infra-red radiations emanating from the discharge envelope means, for the purpose of this Specification, that the absorption and/or reflection of the infra-red radiations by said sleeve is appreciably greater than the absorption and/or reflection of said radiation by a sleeve of similar dimensions formed wholly of soda-glass.

Thus in one form of lamp in accordance with the invention one or more of the sleeves may be wholly or partly formed of a glass which is highly absorbent to the infra-red radiations emanating from the discharge

envelope but which at the same time is transparent to the yellow sodium light.

For example one particular glass which possesses the above properties is the phosphate heat absorbing glass manufactured by Chance Brothers Limited and known as ON20.

Another glass which has good infra-red absorbing properties but which is highly transparent to the yellow sodium light has the following composition by weight:—

P_2O_5	...	67.44%
Al_2O_3	...	13.44%
CaO	...	7.12%
B_2O_3	...	5.00%
SiO_2	...	5.00%
Fe_2O_3	...	2.00%

Other suitable glasses will be apparent to those skilled in the art of glass technology.

In an alternative form of lamp in accordance with the invention one or more of the sleeves may consist of a glass cylinder coated on one or both surfaces with a thin transparent film which has good infra-red absorbing and/or reflecting properties.

Such a film may consist, for example, of a thin coating of a metal such as copper or gold, or alternatively of titanium dioxide or stannic chloride, the thickness of the film being of such a small value that very little absorption of the visible light from the sodium vapour discharge takes place.

The formation of the film on the glass cylinder in such an arrangement may be effected in any convenient manner, depending on the nature of the material from which the film is formed, for example by thermal evaporation, sputtering, or chemical decomposition.

The glass cylinder itself may be formed of a good infra-red absorbing glass as aforesaid although in some cases it may be formed of a common soda-glass, the high infra-red absorbing and/or reflecting properties of the sleeve being provided by the said film or films.

The sleeves in a lamp in accordance with the invention may either be fitted loosely on the limbs of the discharge envelope, that is to say they may merely be slid on to the limbs and held in position by means which restrain the sleeves against relative longitudinal displacement but without the sleeves being attached to the limbs and without the intervention of spacing means between the sleeves and the limbs, or alternatively the sleeves may be attached to the limbs on which they are fitted at one or more regions whose total axial length is small compared with the axial length of the limbs.

For example a lamp in accordance with the present invention may be constructed substantially as shown in and described with reference to the drawings accompanying the Provisional Specification No. 2517/54 or 20306/54, with one or both of the sleeves wholly or partly formed of a glass which is highly absorbent to infra-red radiations, but which is also highly transparent to yellow sodium light, such as one of the glasses hereinbefore specifically referred to.

Alternatively in a lamp as described the sleeves may be formed of ordinary soda-glass coated on one or both surfaces with a thin transparent film having good infra-red absorbing and/or reflecting properties such as copper, gold, titanium dioxide or stannic chloride.

For the Applicants,
J. E. M. HOLLAND,
Chartered Patent Agent.

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